Figure 1 (above). Locality map, prepared by William Besse.

Figure 2 (below). Locality during operations.

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All photos by author unless otherwise noted

La Fluorita Dulcita Prospect

Cochise County Arizona

As a resident of the cool and rainy land of western Washington State, I've often thought how nice it would be to have an excuse to hang around Arizona after my annual sales trip to the Tucson Gem and Mineral Show. A private mineral locality would be ideal. So when a rancher in Cochise County, Arizona, contacted me to do a mineral assessment of his property in 2010, I jumped at the chance. Southwest Cochise County was mineralized by fluids similar to those that produced the orebodies exploited at Bisbee, Gleeson, Tombstone, and Courtland. These fluids produced other vein mineralization not rich in metals but of interest to collectors. I have spent the past two winters exploring these veins on private ranch land.

Figure 4. **Fluorite *ochsenauge* on drusy quartz, 2.1 cm across. Bob Jackson specimen.**

Location

The ranch is located about an hour's drive southeast of Benson, Arizona. As is the case on many ranches near our southern border, the landowner of this occurrence is very sensitive to trespass. One evening in October 2011, we had collected a large pocket until nightfall and so left the property later than usual. As we rounded a bend in the primitive access road, a solitary figure stepped from behind a clump of ocatillo into our headlight beam, pointing an AR-15 semiautomatic rifle directly at the windshield. The rancher had mentioned that it would be a "good idea" to carry a copy of my lease, signed by the owner, when on his property. Although my companions had joked about this, wondering if cattle—seemingly the only living things in this dry country besides us—could read, the rifleman definitely *could* read and permitted us to proceed without problems.

Figure 3. **Author drilling limestone ledges to access fluorite vein, February 2012. Rick Dillhoff photo.**

History

I visited the property just after the Tucson Show in 2011. The rancher's land had no visible indication of mineralization from a distance. A mining company had drilled some test holes a decade ago, probably to sample the contact of Colina Limestone and a small granodiorite stock; a bulldozed drill pad exposed a fluorite and quartz vein that had aroused the rancher's interest. My inspection was brief, but a little trenching exposed some pretty lilac-colored fluorite octahedra on drusy quartz that occurred in "pinch and swell" seams in a shear zone at least 10 meters wide. Having mined this same combination, fluorite on drusy quartz, for twenty-five years at my Rock Candy mine property in British Columbia, Canada, I knew there was a market for this material. I therefore arranged for a lease for the following October.

In October 2011, three of us—my mining partner and fellow Washingtonian, Archer McGill, and Pete McLaughlin of Benson, Arizona—trenched an exposure in a canyon using a Cobra rock drill to explore the shear zone. We opened numerous pockets, all of which contained thin-walled quartz after scalenohedral calcite epimorphs to 10 cm. Most of the hollow epimorphs contained dark purple to lilac fluorite crystals. The dominant form is the octahedron, followed by the cuboctahedron and more complex crystals that appear completely round. Most interesting are those exhibiting *ochsenauge* ("ox-eye" in German) form. These consist of four rounded octahedra and are highly prized from a few European localities. The shape is reminiscent of an orange, quartered, but not cut through as is often used for decoration on

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Bob Jackson is a retired geologist and professional mineral specimen miner.

Figure 5. **Singly and doubly curved fluorite on quartz epimorphic after calcite matrix. Specimen is 32 × 17 × 10 cm with 2-cm fluorite crystals. Pete McLaughlin specimen.**

restaurant buffets. Although I prefer the orange analogy, the oxen have precedence in the literature.

Multiple fluorite/quartz veins crop out on 3 acres of intensely fractured limestone. The largest vein measured 5 meters wide at the surface along a strike distance of 24 meters. Thus far, this vein has produced specimen vugs to a depth of 2.5 meters. Vugs are extremely abundant both in pinch and swell seams and as replacement bodies of drusy quartz after calcite crystals. Vugs range in size from about 15 cm to 3 meters. Oddly, vugs under 15 cm across are uncommon.

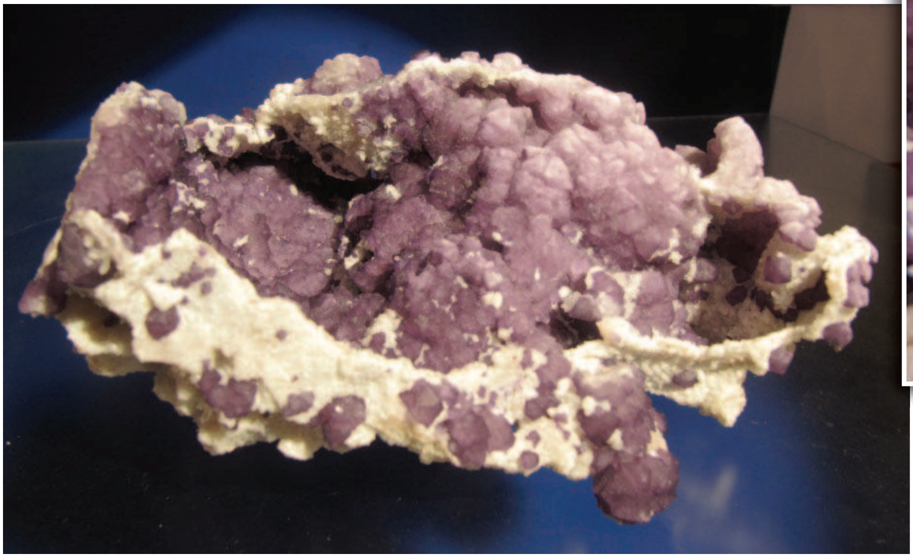
The first five holes we drilled with the Cobra fell into pockets—good omens! However, drilling into pockets, although exciting, tends to stick the drill steel, causing extra work and colorful language. Out of forty-six holes we drilled, we could blast only twenty-one of them. Our initial blast produced so many pockets that the three of us collected for two days before drilling again. Most pockets are filled with sandy drusy-quartz shards surrounding quartz after fluorite epimorphs, which in turn contain the fluorite crystals.

Our one-week venture produced about a half ton of potential specimen material—"potential" because the specimens, as collected, are heavily encased in caliche, making them resemble coral more than mineral specimens. On that first trip, we built a rock retaining wall with several hundred pounds of plates covered in this coralloid-caliche before realizing that there were purple octahedra of fluorite buried within. Initially, we removed the caliche with dilute HCl, but it seemed to dull the luster of the fluorite, so we tried CLR, Calcium/Lime/Rust remover, a commercial cleaning product. CLR turns caliche into a slippery mass of calcium lactate that looks as if a vanilla milkshake has been left out in the Arizona sun to curdle. CLR is expensive, so we now use lactic acid, the main ingredient in CLR.

After the 2012 Tucson Show we brought an air drill and trailer-mounted compressor to remove a limestone cap to permit us to explore the vein further. The largest pocket were opened was big enough to crawl into. Current plans are to continue collecting the surface exposure of the veins, about 18 meters of which remain, before the topography would require underground mining.

Geology

Southwest Cochise County, Arizona, is underlain by Precambrian schists and Paleozoic sediments that were subsequently intruded by monzonites, quartz latites, and granitic



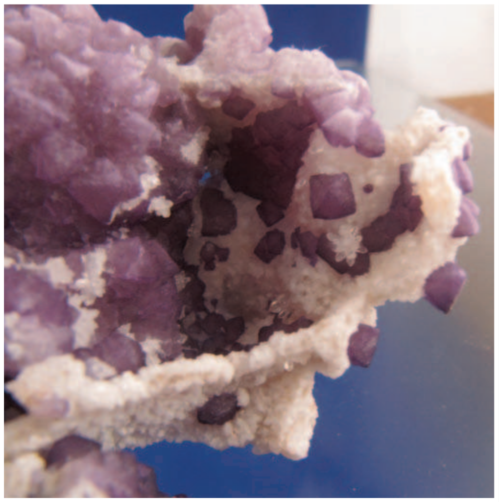


Figure 6 (left). **Fluorite octahedra in 8-cm quartz after calcite epimorph. John Gordon specimen.**

Figure 7 (above). **Detail of specimen in figure 6. Octahedra are 0.5 cm.**

stocks and dikes. These intrusions generated mineralizing fluids that altered and replaced sediments and megabreccias that were formed as large terranes by thrust faulting. Metalliferous orebodies have been widely mined. Mineralized fractures in the Earp and Colina formations, however, contain nonmetallic mineralization of interest to mineral collectors (Gilluly 1956).

Minerals

Fluorite, CaF_2, occurs as sharp purple to lilac octahedra and cuboctahedra to 1 cm. About half the octahedra that are more than 1 cm show curved faces. Multiple octahedra that crystallized in close proximity have more pronounced curves—the best examples being the *ochsenauge*/quartered-orange morphology. A search of fluorite literature has not turned up any mode of formation for curved fluorite. Dr. R. Peter Richards suggested in personal communication (2012), "I presume the lobes are still parts of a single crystal (more or less) and represent overgrowth on each octahedral face that for some reason did not continue across the edges between the faces. I would not be surprised if they were akin to spherical growth in fluorite (White 2008), such as those spheres from India, but occurring on an already grown octahedral crystal. The question of why they did not fill in the fissures is a very interesting one!"

European localities for *ochsenauge* fluorite are Schoenbruck, Saxony, Germany, and Pont Gibeaud, Puy-de-Dôme, France (Mindat.org).

Figure 8. **Pete McLaughlin in a 2.2-meter-long fluorite vug, March 2012.**

Figure 9. **Fluorite cuboctohedra on quartz epimorphs after calcite. Field of view 21 cm.**

Quartz, SiO_2, is present as drusy coatings on all rock surfaces and as epimorphs after calcite. Scalenohedral calcite crystal cavities that were formed by a thin layer of drusy quartz are as large as 10 cm. These epimorphs make an attractive substrate for fluorite crystals. It appears that a quartz/fluorite solution invaded a karst area with abundant lenses of crystallized calcite. Vug walls show signs of water flow prior to mineralization. Quartz coated both sharp scalenohedra and acute rhombohedra of calcite; the faces and edges are clearly visible in the resulting epimorphs. Yellow stalactitic calcite that formed after crystallization of the fluorite is the only remaining calcite.

Conclusions

This occurrence has produced some very desirable fluorite specimens on quartz. However, the locality is small. Our current exploration target is along an area of intensely silicified limestone that forms the footwall of the second largest vein. The landowner has extended our exclusive lease for another year, by the end of which we should know if La Fluorita Dulcita prospect will be an ongoing producer of specimens or a footnote in fluorite collecting history. Occasionally, collector access is available through GeologyAdventures.com.

ACKNOWLEDGMENTS

This deposit could not have been explored without the cooperation of the landowner, who wishes to remain anonymous, and the able help of Archer McGill and Pete McLaughlin. GeologyAdventures.com helped finance the project. This article was much improved by its reviewers: Steve Chamberlain and Bob Cook. I thank William Besse for preparing the map and Drs. R. Peter Richards and Bob Downs for ongoing discussions on crystal growth.

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